

TS78 - MEASURING PERFORMANCE

12286 Automated Traffic Signal Performance Measures
– A Simplified Alternative Architecture



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Opportunity – UDOT Executive Leaders - 2011

“What would it take for UDOT’s traffic signals to be World-Class?”



John Njord



Carlos Braceras




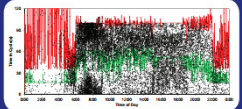
QIT Recommendations (July 2011)

- Require that communications and signal detection be maintained during projects.
- Transition from reactive to proactive signal maintenance by increasing signal maintenance funding.
- **Implement real-time monitoring of system health and quality of operations.**
 - ❖ Automated Traffic Signal Performance Measures (SPM's)




Beginning of SPM's for UDOT

**PERFORMANCE MEASURES FOR
TRAFFIC SIGNAL SYSTEMS**

An Outcome-Oriented Approach







Christopher M. Day, Darcy M. Bullock, Howell Li, Stephen M. Remias, Alexander M. Hainen,
Richard S. Freije, Amanda L. Stevens, James R. Sturdevant, and Thomas M. Brennan


ITE Journal, March 2014

feature



**Helping Traffic Engineers Manage
Data to Make Better Decisions**

Automated Traffic Signal Performance Measures

By Darcy Bullock, P.E., Rob Clayton, P.E., PTOE, Jamie Mackey, P.E.,
Steve Misgen, P.E., PTOE, Amanda Stevens, P.E., Jim Sturdevant, P.E.,
and Mark Taylor, P.E., PTOE

Improved signal operations with smooth and equitable traffic flow are goals for most traffic engineers; however the limited snapshot-view retiming methods that involve manual data collection, traffic signal modeling, and field fine-tuning are resource intensive and unresponsive to changes in traffic patterns. The National Transportation Operations Coalition's 2012 National Traffic Signal Report Card has led agencies to focus resources on these activities and develop methodologies to examine all the components of traffic signal operations.¹ These data-driven program management plans provide objective methods for identifying shortcomings and encourages coordination with neighboring jurisdictions. In addition, agencies need tools to prioritize activities when resources are constrained.

www.ite.org March 2014 33

SPM's –Requirements & How it Works

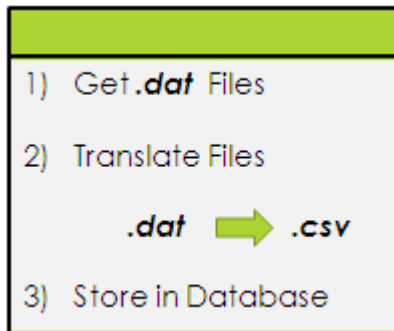


1) High-resolution Controller

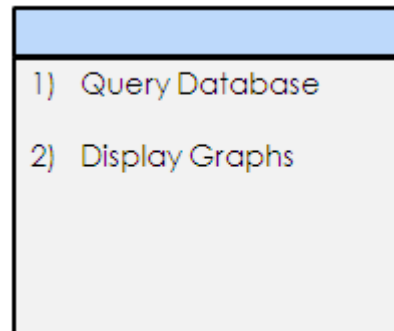
- Econolite Cobalt: Any Version
- Econolite ASC3 NEMA: V. 2.50+ & OS 1.14.03+
- Econolite 2070 with 1C CPU Module: V. 32.50+
- Intelight Maxtime: V. 1.7.0+
- Peek ATC Greenwave 03.05.0528+
- Trafficware 980ATC V. 76.10+
- Siemens M50 Linux & M60 ATC
 - ECOM V. 3.52+
 - NTCIP V. 4.53+



2) Communications



3) Server



4) Website



5) Detection

Can be done independent of a Central System!

September 10, 2014

Metrics & Detection Requirements

Controller high-resolution data only

Purdue Phase Termination
Split Monitor



Advanced Count Detection (~400 ft behind stop bar)

Purdue Coordination Diagram
Executive Summary Reports

Arrivals on Red
Approach Delay

Approach Volume
Link Pivot (future)

Advanced Detection with Speed

Approach Speed

Lane-by-lane Presence Detection

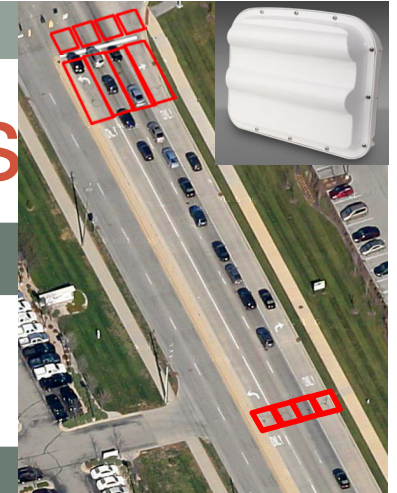
Purdue Split Failure (future)

Lane-by-Lane Count Detection

Turning Movement Counts
Red Light Monitoring (future)

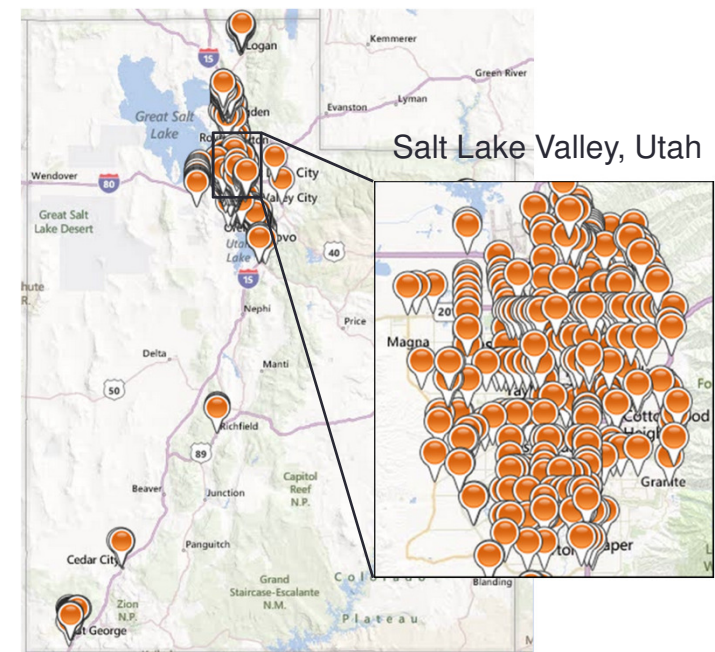
Probe Travel Time Data (GPS or Bluetooth)

Purdue Travel Time Diagram



UDOT's SPM Website – Available to All

The screenshot shows the UDOT Signal Performance Metrics website. The header includes the UDOT logo and the title "Signal Performance Metrics". Below the header, there are navigation tabs: "Charts", "Reports", "Log Action Taken", "Links", and "FAQ". The main content area is titled "Signal Metrics" and features a "Selected Signal" dropdown menu with "7063 Bangerter Hwy (SR-154) 5400 South (SR-173)" selected. There are also dropdowns for "Region" (set to "All") and "Metric Type" (set to "All"). A "Filter" button and a "Clear Filter" button are present. Below these, there is a "Signal List" section with a "Map" button. The map shows a view of Utah with several orange location pins. To the right of the map, there are "Metric Settings" including a "Metric Type" section with radio buttons for "Approach Delay", "Approach Volume", "Arrivals On Red", "Purdue Phase Termination", "Speed", and "Split Monitor". There is also a "Consecutive Count" dropdown set to "1". Below the settings, there are "Dates" fields for "Start Date" (8/27/2014) and "End Date" (8/27/2014), with a "Reset Date" button and a calendar view for August 2014. At the bottom right, there is a "Create Metrics" button.

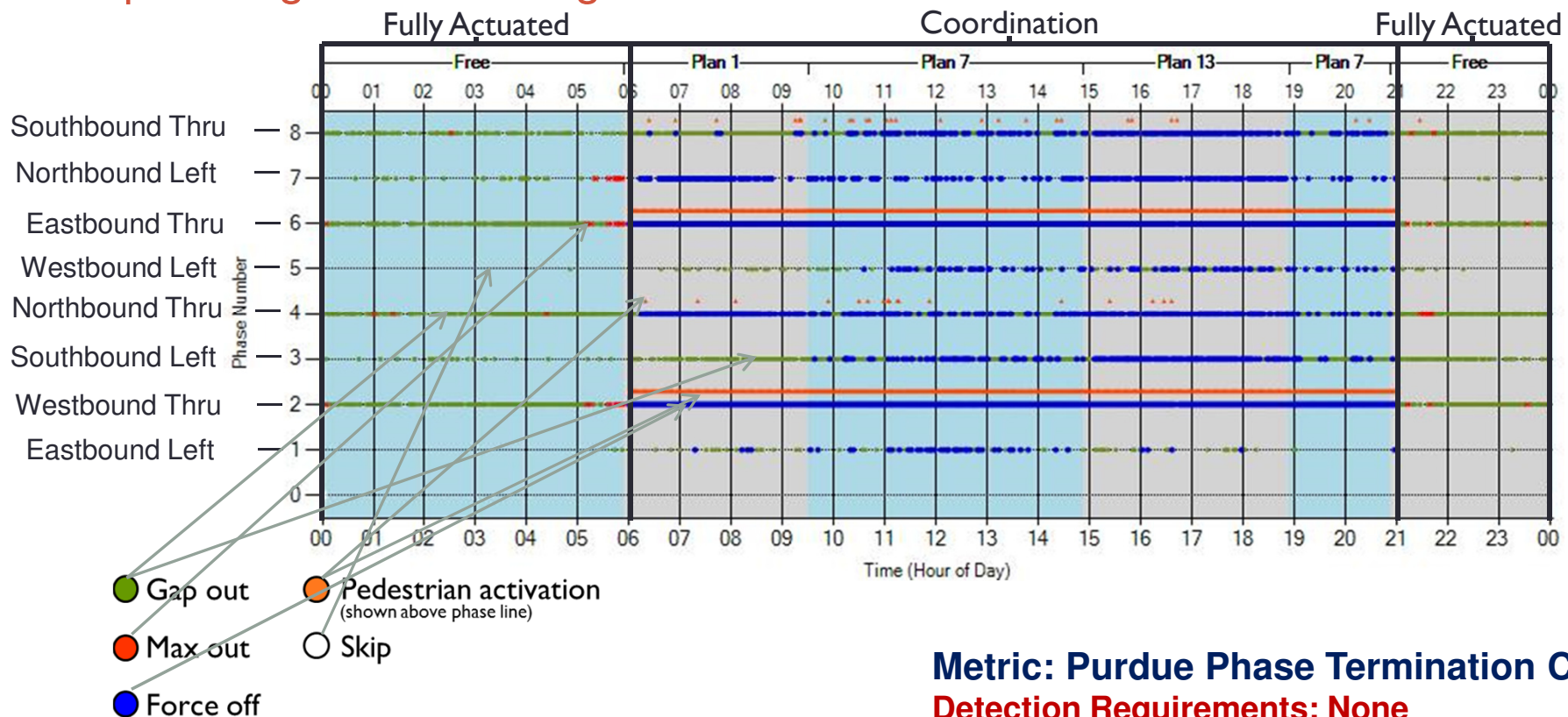


1250 of 1900 Utah Traffic Signals

<http://udottraffic.utah.gov/signalperformancemetrics>

Normal Intersection Example:

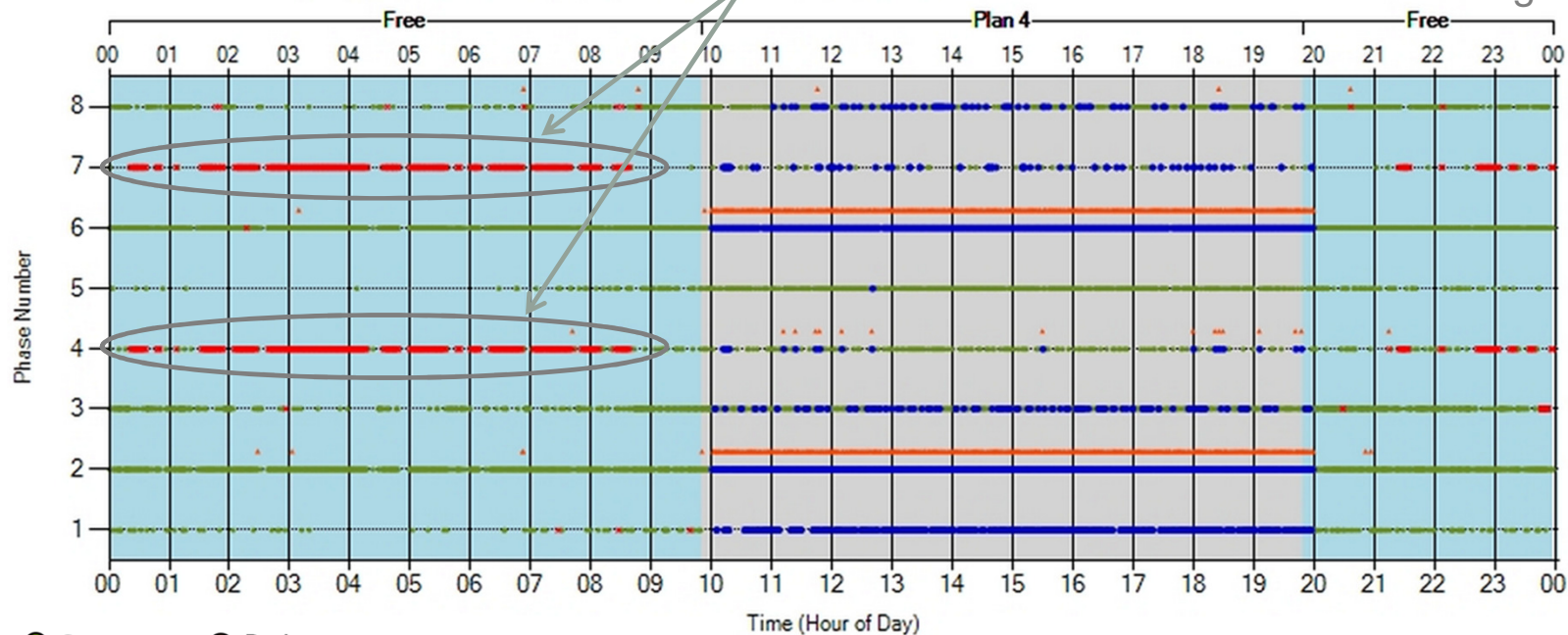
8-phase signal with working detection



Maintenance Example:

Nighttime Detection Problem (Before)

Minor street thru & left turn max out at night only



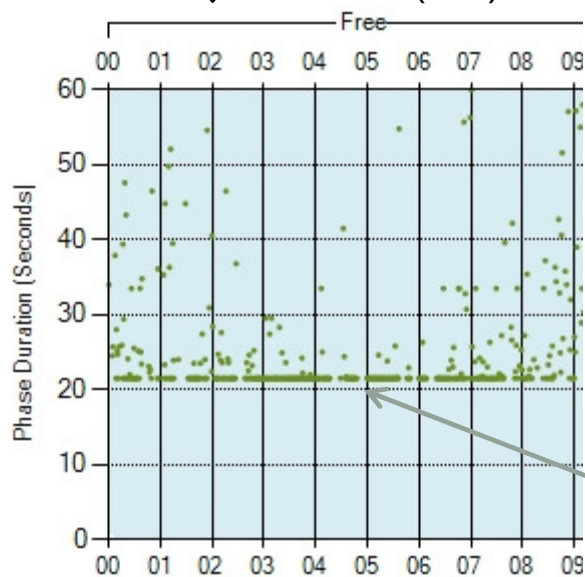
- Gap out
- Pedestrian activation
(shown above phase line)
- Max out
- Skip
- Force off

Metric: Purdue Phase Termination Chart
Detection Requirements: None

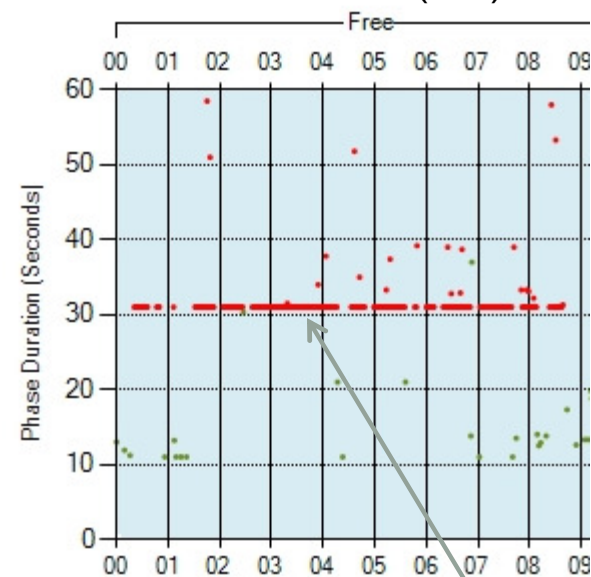
Maintenance Example:

Nighttime Detection Problem (Before)

Major Street (Ø2)



Minor Street (Ø4)



- Gap out
- Pedestrian activation
(shown above phase line)
- Max out
- Skip
- Force off

Major Street sees 20 s of green and 30 s of red

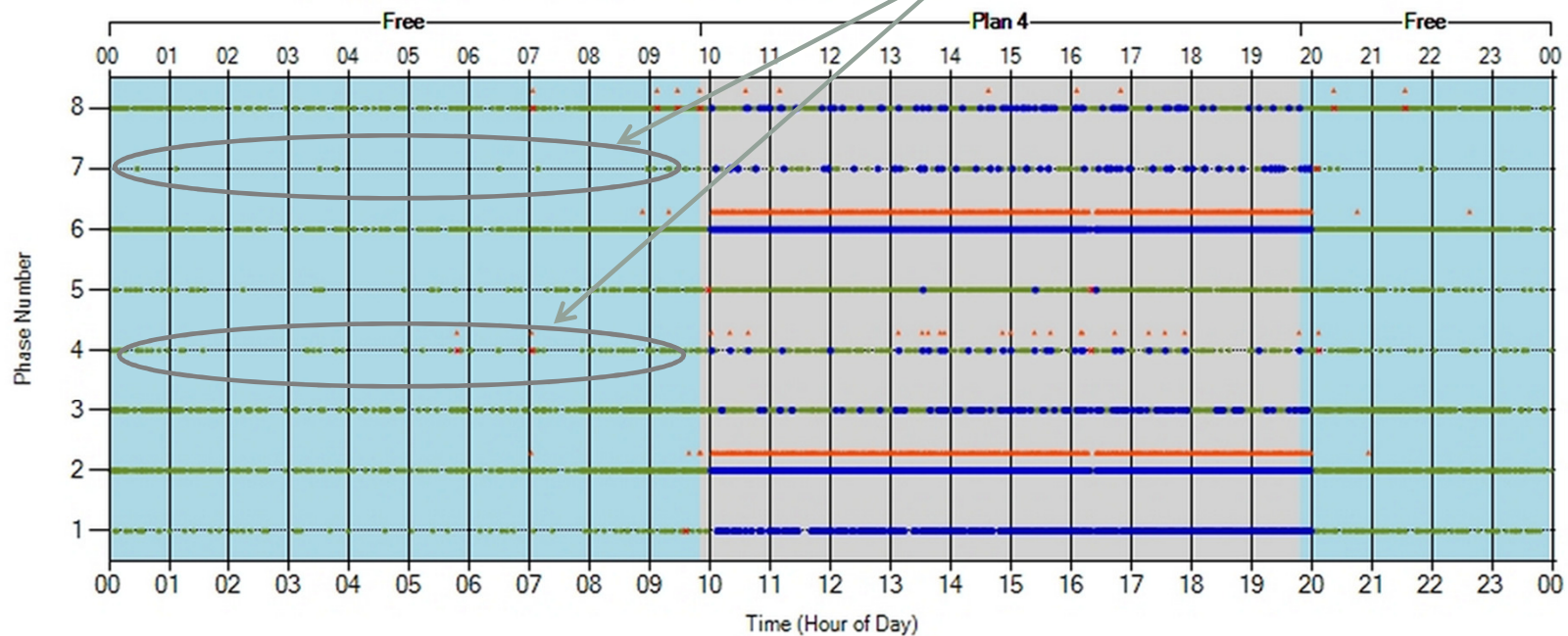
Metric: Split Monitor

Detection Requirements: None

Maintenance Example:

New Detection Technology Installed (After)

Phases are rarely used at night

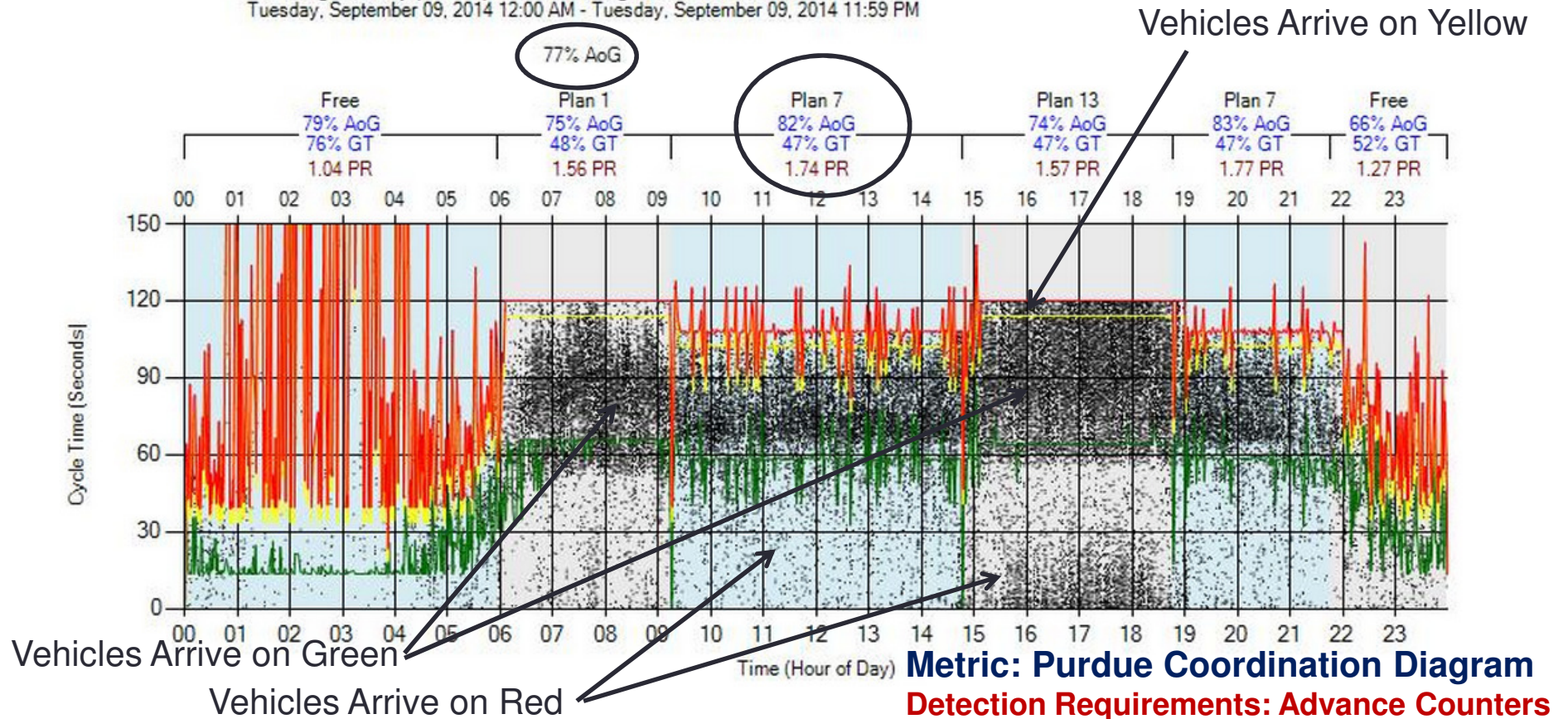


- Gap out
- Pedestrian activation (shown above phase line)
- Max out
- Skip
- Force off

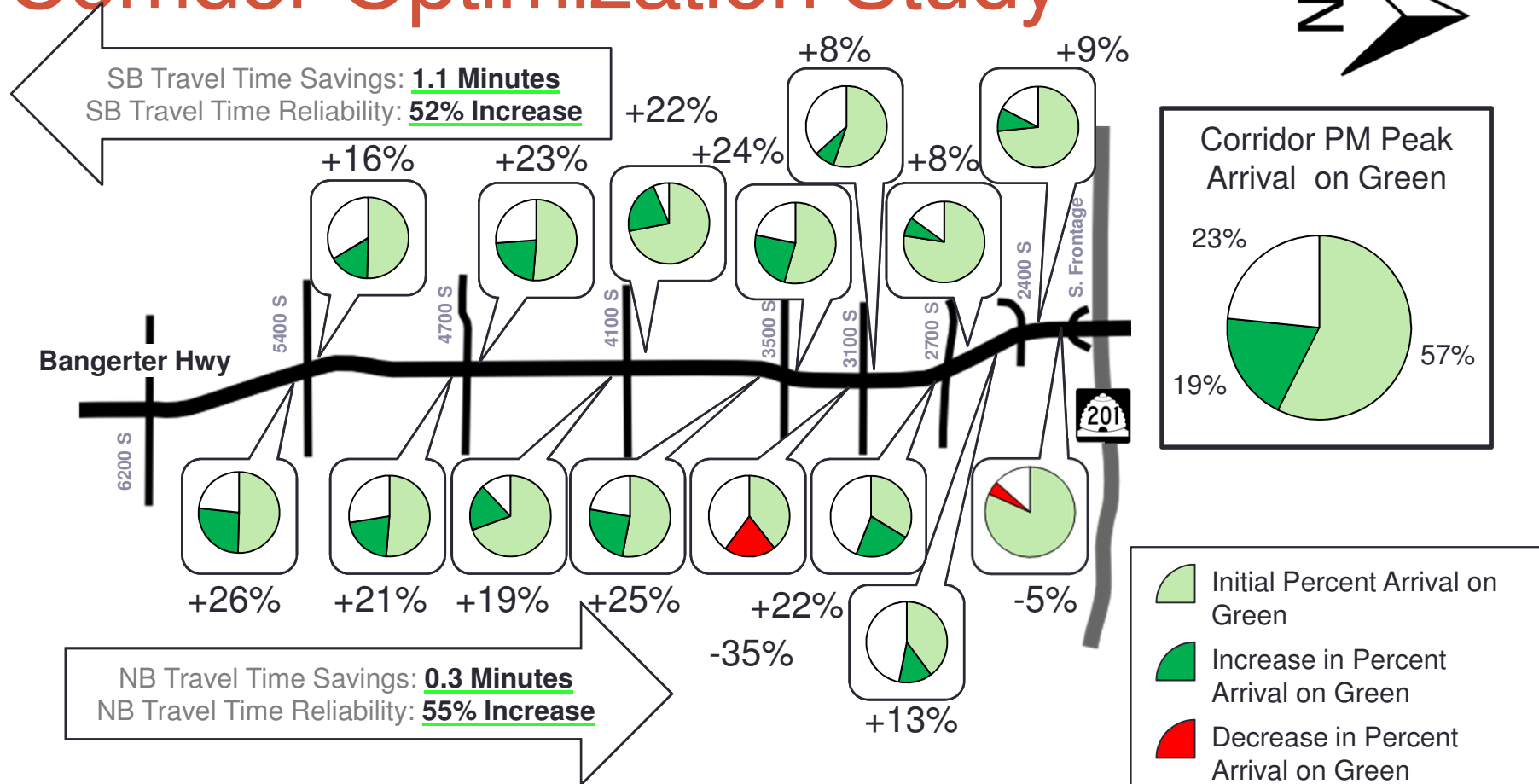
Metric: Purdue Phase Termination Chart
Detection Requirements: None

Coordination Optimization Example: Progression Quality

Bangerter Hwy (SR-154) 10400 South Signal 7364 Phase: 6 Southbound
Tuesday, September 09, 2014 12:00 AM - Tuesday, September 09, 2014 11:59 PM



Corridor Optimization Study



Executive Reports & Prioritizing:

Statewide Summary 24 hours / day In Utah, USA

Month	Arrival on Red		Volume	Intersections	
Month	Percent	Platoon Ratio	Daily Average Per Approach	Total	Number of Approaches
Aug 2014	30%	1.16	10,740	414	843

- Region, corridor, and intersection summaries also available.
 - Prioritize coordination projects where they're needed the most.
- Software project to breakdown by time-of-day instead of 24/7.
- Engineers could now **directly measure** what previously they could only **estimate and model**.

Metric: Executive Reports

Detection Requirements: Advance Counters

Automated Traffic Signal Performance Measures

AASHTO Innovation Initiative (formally TIG) 2013 Focus Technology

Mission: Investing time and money to accelerate technology adoption by agencies nationwide



Thank You!

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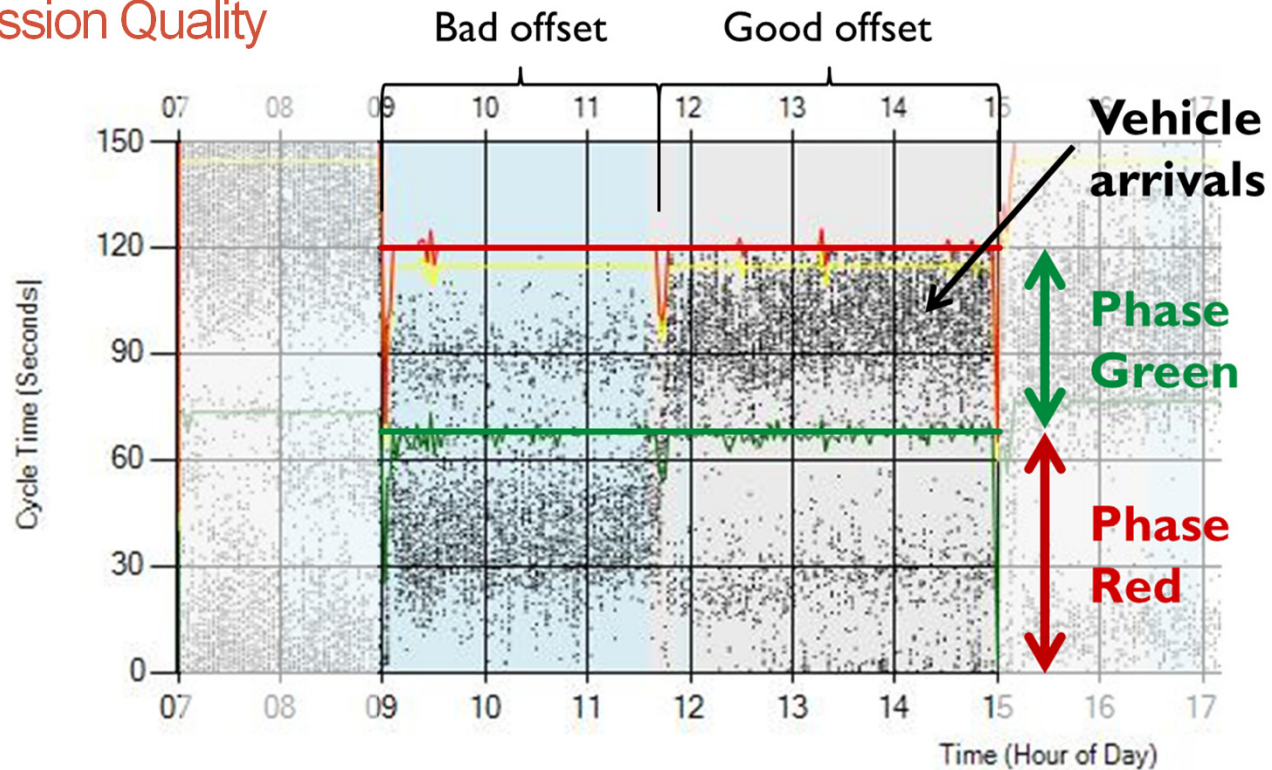
<http://udottraffic.utah.gov/signalperformancemetrics>

Controllers with Indiana Datalogger Enumerations

- Econolite Cobalt: Any Version
- Econolite ASC3 NEMA: V. 2.50+ & OS 1.14.03+
- Econolite 2070 with 1C CPU Module: V. 32.50+
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Coordination Optimization Example:

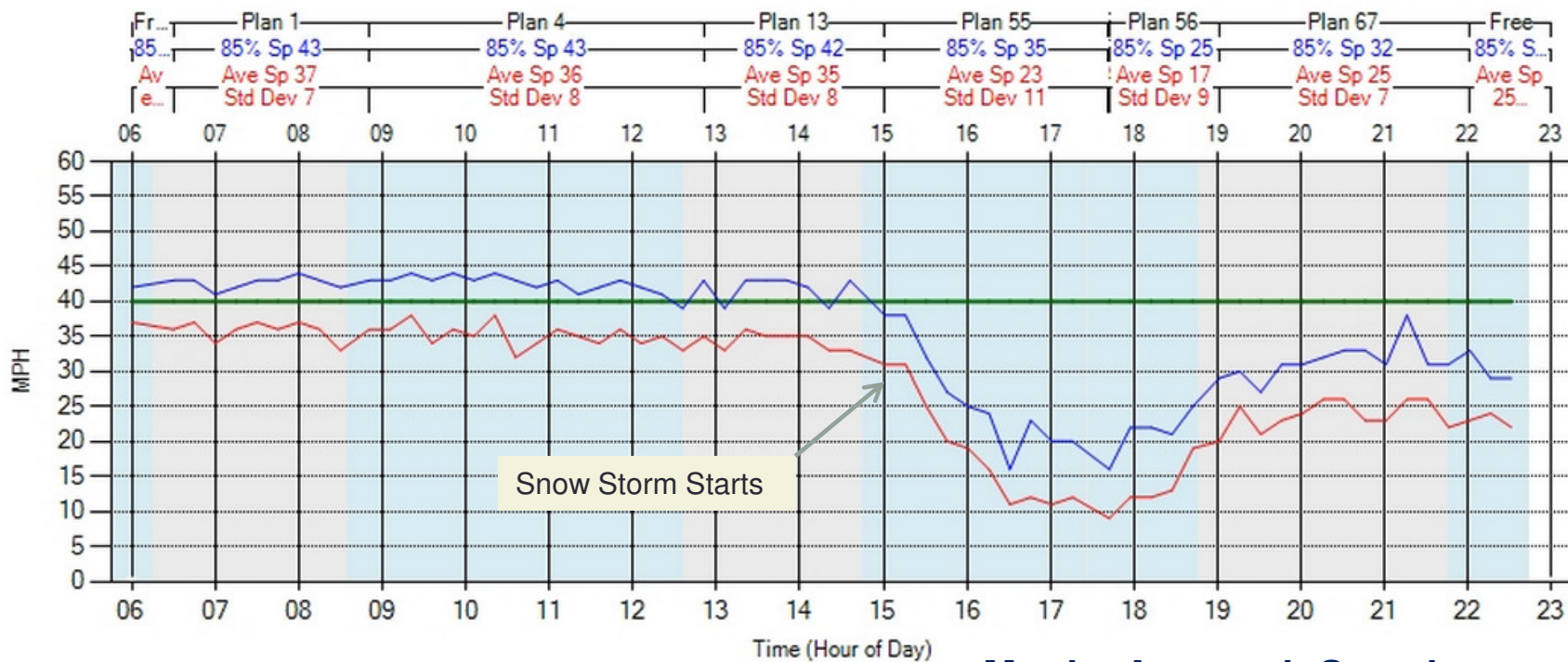
Progression Quality



Metric: Purdue Coordination Diagram
Detection Requirements: Advance Counters

Operations & Traffic Study Example:

Vehicle Speeds at Intersections



Metric: Approach Speeds

Detection Requirements: Advance Radar